CLAIMS

what is claimed is:

1. An apparatus for engaging a work piece during plating, the apparatus comprising:

a cup having a circumferential side wall defining an interior region and a lip within the interior region arranged such that lip can support the work piece while the work piece remains within the interior region;

a field shaping element shaped and sized to affect an electric field shape impinging on the work piece during plating, the field shaping element designed for connection with the cup;

a flow path defining a passage for plating fluid to flow from inside the apparatus to outside the apparatus, said flow path residing in a region between the field shaping region and the cup and having an inlet on the inside of the apparatus and an outlet on the outside of the apparatus and positioned such that the outlet is at a higher elevation than the inlet when the apparatus oriented for use with the cup above the field shaping element; and

a cone having a work piece contact surface that fits within the cup's interior and can contact the work piece in a manner that holds the work piece in a fixed position against the cup's lip.

2. The apparatus of claim 1, wherein the cup's lip is sized and shaped to support a semiconductor wafer work piece.

3. The apparatus of claim 2, wherein the cup's lip comprises a lipseal made from a material that provides a fluid tight seal with the semiconductor wafer when the wafer is held in place by the cone.

4. The apparatus of claim 3, wherein the lipseal material is an elastomer.

5. The apparatus of claim 1, wherein at least a portion of the cup facing the inside of the apparatus is made from a material selected from the group consisting of a ceramic, plastic-coated ceramic, plastic-coated metal, glasses, glass-coated metals, and composites.

6. The apparatus of claim 5, wherein a plastic used in the coating of the plastic-coated ceramic or metal is a fluoropolymer.

7. The apparatus of claim 5, wherein the ceramic or a ceramic used in the plastic-coated ceramic is alumina or zirconia.

8. The apparatus of claim 1, further comprising one or more actuators for moving the work piece into and out of the plating fluid, while the work piece is held in position by the cup and cone.

9. The apparatus of claim 8, wherein the one or more actuators can pivot the work piece about an axis defined on or proximate the work piece.

10. The apparatus of claim 1, wherein the cup and the field shaping element together form a unitary element.

11. The apparatus of claim 1, wherein the cup and the field shaping element are separate elements held in fixed positions with respect to one another by a fastener.

12. The apparatus of claim 11, wherein the fastener allows a separation distance between the cup and field shaping element to be adjusted to thereby adjust a dimension of the flow path.

13. The apparatus of claim 1, wherein said flow path has a slot shape that is substantially coextensive with the cup's circumferential side wall.

14. The apparatus of claim 1, wherein said flow path has a hole shape.

15. The apparatus of claim 14, further comprising additional hole shaped flow paths distributed about the cup's circumferential side wall.

16. The apparatus of claim 14, wherein the inlet to the flow path has a grooved channel.

17. The apparatus of claim 14, wherein the flow path is angled at an offset angle from a radial vector from a center line inside the apparatus toward the outside of the apparatus.

18. The apparatus of claim 1, wherein a portion of the cup separating the lipseal from the flow path has a thickness of between about 0.25 and 2.0 millimeters.

19. The apparatus of claim 1, wherein a portion of the cup separating the lipseal from the flow path has a thickness of between about 0.5 and 1.25 millimeters.

20. The apparatus of claim 1, wherein the flow path length is between about 30 and 60 millimeters.

21. The apparatus of claim 1, wherein the flow path length is between about 35 and 50 millimeters.

22. The apparatus of claim 17, wherein the offset angle is between about 25 and 50 degrees.

23. The apparatus of claim 17, wherein the offset angle is about 45 degrees.

24. A method of plating a material onto a work piece, the method comprising:

holding the work piece between a cone and a cup of an apparatus, wherein the cup has a circumferential side wall defining an interior region and a lip within the interior region and supporting the work piece while the work piece remains within the interior region, and wherein the cone has a work piece contact surface that fits within the cup's interior and contacts the work piece in a manner that holds the work piece in a fixed position against the cup's lip; and

while plating, directing a plating fluid through a flow path defining a passage for the plating fluid to flow from inside the apparatus to outside the apparatus, said flow path having an inlet on the inside of the apparatus and an outlet on the outside of the apparatus and positioned such that the outlet is at a higher elevation than the inlet, whereby gas present in a portion of the plating fluid in the flow path travels toward the outlet due to its buoyancy.

25. The method of claim 24, further comprising directing the plating fluid toward a substantially flat plating surface of the work piece, thereby setting up a circulation pattern in which the plating fluid flows along the plating surface and through the flow path.

26. The method of claim 24, further comprising rotating the work piece about an axis substantially parallel to the circumferential side-wall.

27. The method of claim 24, further comprising immersing the work piece in the plating fluid prior to plating.

28. The method of claim 27, wherein the work piece has a substantially flat plating surface and wherein immersion of the work piece takes place at an angle in which the plating surface is not parallel to a plane defined by the plating fluid surface.

29. The method of claim 24, wherein work piece is a semiconductor wafer.

30. The method of claim 29, wherein the work piece is positioned on a lipseal of the lip to thereby provide a fluid tight seal with the semiconductor wafer when the wafer is held in place by the cone.

31. The method of claim 24, wherein at least a portion of the cup facing the inside of the apparatus is made from a material selected from the group consisting of a ceramic, plastic-coated ceramic, plastic-coated metal, and composites.

32. The method of claim 24, further comprising fastening the cup to a field shaping element together at a specified separation distance to thereby define a dimension of the flow path.

33. The method of claim 32, further comprising adjusting the separation distance to thereby adjust the dimension of the flow path.

34. The method of claim 24, wherein said flow path has a slot shape that is substantially coextensive with the cup's circumferential side wall.

35. The method of claim 24, wherein said flow path has a hole shape.

36. The method of claim 35, further comprising additional hole shaped flow paths distributed about the cup's circumferential side wall.

37. The method of claim 35, wherein the inlet to the flow path has a grooved channel.

38. The method of claim 35, wherein the flow path is angled at an offset angle from a radial vector from a center line inside the apparatus toward the outside of the apparatus.

39. The method of claim 24, wherein the plating fluid is an electrolyte and electroplating is the method of plating.

40. The method of claim 24, wherein the plating fluid contains metal ions and electroless plating is the method of plating.